

# REPORT DOCUMENTATION PAGE

Form Approved  
OMB No. 0704-0188

Public reporting burden for this collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any aspect of this collection of information, including suggestions for reducing the burden, to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 22202-4302, and to the Office of Management and Budget, Paperwork Reduction Project (0704-0188), Washington, DC 20503.

1. AGENCY USE ONLY (Leave blank) 2. REPORT DATE July 1986 3. REPORT TYPE AND DATES COVERED 1984/1985

4. TITLE AND SUBTITLE "A High-Speed digital camera system for flow visualization." 5. FUNDING NUMBERS AFOSR-85-0041

6. AUTHOR(S) C.T. Bowman

7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) Department of Mechanical Engineering Stanford University. 8. PERFORMING ORGANIZATION REPORT NUMBER

9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES) US Air Force. 10. SPONSORING/MONITORING AGENCY REPORT NUMBER

11. SUPPLEMENTARY NOTES

12A. DISTRIBUTION/AVAILABILITY STATEMENT Approved for public release; distribution unlimited. 12B. DISTRIBUTION CODE

13. ABSTRACT (Maximum 200 words) DTIC ELECTE JUL 24 1990

14. SUBJECT TERMS 15. NUMBER OF PAGES 16. PRICE CODE

17. SECURITY CLASSIFICATION OF REPORT Unclassified 18. SECURITY CLASSIFICATION OF THIS PAGE Unclassified 19. SECURITY CLASSIFICATION OF ABSTRACT Unclassified 20. LIMITATION OF ABSTRACT Unclassified

NSN 7540-01-280-5500

Standard Form 298 (890104 Draft)  
Prescribed by ANSI Std. Z39-18  
298-101

80 07 25 008

AD-A224 542

DTIC FILE COPY

Final Scientific Report

URIP FY 84 - 85

**"A High-Speed Digital Camera System for Flow Visualization"**

AFOSR-85-0041

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DTIC TAB	<input type="checkbox"/>
Unannounced	<input type="checkbox"/>
Justification	
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Distribution /	
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A-1	

July 1986

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## Final Scientific Report

### SUMMARY

This grant enabled the purchase of a Spin Physics S-2000 high-speed digital camera system for use on DoD-sponsored research on turbulent reacting flows. The camera system has been employed to obtain high-speed schlieren images of pulsed jet flames and of the flow field in a dump plane combustor. In addition, the camera system has been coupled to a pulsed copper vapor laser to obtain planar images of Mie scattering from small refractory seed particles in reacting flows. These particle images can be used to obtain instantaneous planar images of the velocity field.

### SYSTEM DESCRIPTION

The Spin Physics SP-2000 Digital Camera System comprises a microprocessor-controlled fast-readout MOS solid-state sensor array (192 x 240 pixels) coupled to an ultra high-density magnetic tape data recorder. Important operating characteristics include: (1) high-framing rate (the system can record up to 12,000 images per second); (2) extended recording times (the system can store 540,000 sequential images, corresponding to a recording time of 45 seconds at 12,000 images per second); (3) fast data display (the system allows instantaneous slow motion tape review of the data after recording); (4) provision for direct computer interfacing (recorded images can be directly transferred to external computers for image processing); (5) user friendly (the system is controlled from a built-in console); and, (6) external triggering capability (the camera can be used to trigger an external light source, such as a pulsed laser, for stroboscopic imaging).

### DESCRIPTION OF RESEARCH

The Spin Physics camera system has been used to obtain time-resolved flow field images in several turbulent reacting flows. Conventional schlieren images of a pulsed jet flame and of the flow field in a dump plane combustor have been recorded. In addition, the camera system has been coupled to a pulsed copper vapor laser to obtain stroboscopic images

of Mie scattering from small refractory seed particles in the pulsed jet flame. An example of these images is shown in Figure 1. The complex nature of this flow is evident in the image. In addition, the Mie scattering technique is being developed to obtain instantaneous planar velocity images in reacting flows. In this application, multiple pulses from the copper vapor laser are recorded on a single image, and the velocity field is constructed from particle streaks.

#### SYSTEM LOCATION

The Spin Physics Camera System is located in the High Temperature Gasdynamics laboratory on the Stanford campus. However, since the system is portable it has been used on research programs in other laboratories on campus, notably for flow visualization in the Department of Aeronautical Engineering.

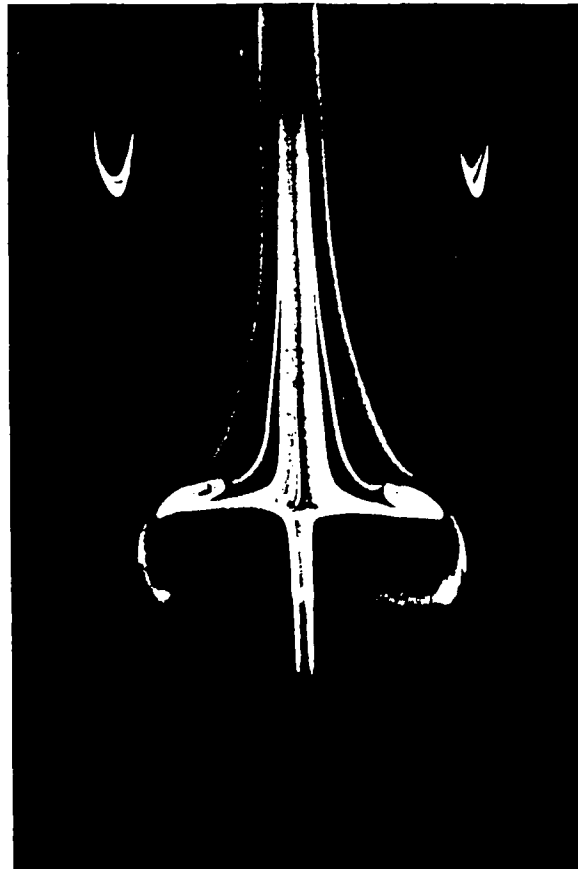


Figure 1. Image of flame radiation and Mie scattering from  $\text{TiO}_2$  seed particles in a pulsed laminar non-premixed methane-air flame.